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FOREST PEST MANAGEMENT
Pacific Southwest Region

Report No. 86-20

3420 Biological Evaluation
November 5, 1986

BIOLOGICAL EVALUATION OF DWARF MISTLETOE IN RED FIR ADVANCED REGENERATION FOLLOWING OVERSTORY REMOVAL, FOSTER MEADOWS TIMBER SALE, AMADOR RANGER DISTRICT, ELDORADO NATIONAL FOREST

Gregg DeNitto, Forest Pathologist
Forest Pest Management

Robert Scharpf, Forest Pathologist
Pacific Southwest Forest and Range Experiment Station

David Schultz, Entomologist
Forest Pest Management

ABSTRACT

Red fir advanced regeneration in a stand in the Foster Meadows timber sale was evaluated for the significance and future impact of dwarf mistletoe. The overstory has been harvested and the residual stand is generally overstocked with some understocked and non-stocked areas. Dwarf mistletoe was present in portions of the residual stand, although infections were not seen in the seedling-size class. Some of the residual trees, especially the larger size classes, were damaged during logging and had basal wounds on their boles. Three management alternatives are presented and discussed. By taking no action, the advanced regeneration will not be released and the stand will stagnate. Dwarf mistletoe will intensify in infected trees and spread in the stand to uninfected red fir. The growth potential of the stand will not be achieved. Wounded trees will remain in the stand and their boles will decay. Reduced tree growth will slow wound healing which will allow continued progression of decay. A second alternative would be to prepare and regenerate the site, thereby eliminating dwarf mistletoe from the stand at the expense of losing the advanced regeneration. This will also minimize the volume lost to

USDA, FOREST SERVICE, PACIFIC SOUTHWEST REGION
State and Private Forestry, Forest Pest Management
630 Sansome Street, San Francisco, California 94111

decay at harvest within the projected rotation age. A third alternative would be to retain the advanced regeneration and precommercially thin dense aggregates. This would provide sufficient release for trees to respond in growth at rates greater than the dwarf mistletoe can spread. Projected volumes will then be attained at rotation age. Regenerating understocked areas will allow the site to reach its potential yield. Increased tree vigor will increase the healing of wounds and lessen the amount of decay and cull in future commercial entries. Not treating the invading lupine and grass in understocked areas prior to any regeneration attempts will increase the likelihood of damage by pocket gophers to any planted seedlings.

INTRODUCTION

At the request of the Forest Supervisor, Eldorado National Forest, we met with Stewart Craig, District Silviculturist, Amador Ranger District, on August 6, 1986 and visited a stand in the Foster Meadows timber sale. The purpose of our visit was to evaluate the significance of dwarf mistletoe in the red fir advanced regeneration in the stand and to determine if the pathogen would limit or alter silvicultural options available. Management direction for this stand is to optimize timber yield using even-age management systems.

OBSERVATIONS

Harvesting of the overstory in this 41-acre red fir stand was completed in the fall of 1985. Most of the commercial overstory was removed, leaving a stand of seedling to small sawlog red fir. Heights of residual trees ranged from seedlings to greater than 100 feet. Density of the regeneration ranges from non-occupied sites to very dense aggregations. The openings and lightly stocked areas are filling in rapidly with lupine and grasses. Site quality is at least a Site Class II.

Following overstory removal the stand is 51% stocked with potential crop trees and has an average of 1225 stems/acre. There are 110 crop trees/acre distributed approximately on a 16 foot spacing. The following estimates describe the average potential crop tree.

Height = 16.6 feet
Age = 54 years
Live crown ratio = 90%
Previous 3 year height growth = 2.8 feet
Previous 10 year diameter growth = 1.49 inches
Crown diameter = 5.2 feet

Much of the sapling and pole-size red fir bore plants of red fir dwarf mistletoe, Arceuthobium abietinum f. sp. magnificae. Dwarf mistletoe plants were not seen in the seedling-size regeneration. This may be a result of the seedlings not having been infected or of latency of the parasite. In the larger trees, infections were most common in the lower crown, but did extend into the upper crown of some trees. An average stand dwarf mistletoe rating of the potential crop trees was not determined.

A common parasite in the red fir was Melampsorella caryophyllacearum, the cause of yellow witches' broom. This fungus infects true firs and species of chickweed. In red fir, the foliage appears yellow and shortened and is often part of a compact witches' broom. The disease may cause some bole deformation and, in severe cases, reduced growth, but it is usually not a significant problem. The symptoms of yellow witches' brooms may be confused with dwarf mistletoe, however, and care should be taken to discern between the two when marking trees for removal.

Logging damage was common. Many of the larger residual trees had sizeable wounds on the lower 6 feet of their bole. Several square feet of bark were missing in some cases. Some seedlings also had stem wounds from logging. In general, tree crowns were not significantly damaged during logging.

During reconnaissance of the stand, a conk of Fomes annosus, a root disease fungus, was found in an old red fir stump from an earlier harvest. This disease had not been causing an observable impact on the stand prior to harvest.

BIOLOGY OF RED FIR DWARF MISTLETOE

Red fir dwarf mistletoe, Arceuthobium abietinum f. sp. magnificae, is a seed-bearing plant that parasitizes only red fir. It will not survive without living host tissue, which it depends on for support, food, nutrients, and water.

Dwarf mistletoes initiate their life cycle when a seed lands on a needle or small twig of a host. The seed is coated with viscin, a sticky substance that allows it to adhere to the host tissue. During rains, the viscin becomes mucilaginous, allowing the seed to slide down to the needle base where it may lodge. The seed germinates in the winter or spring and the radicle grows along the twig until it reaches a needle base or bark irregularity. The radicle forms a holdfast and penetrates the twig into the xylem. A type of root system then develops in the twig. In 3 to 5 years from seed deposition, most successful infections will appear as branch swellings and will bear mistletoe shoots. These shoots will not produce fruit until at least 5 years following seed deposition, the average being 8-9 years. Fruit mature in the fall and disseminate seed in September and October. The seeds are explosively discharged from the fruit through the buildup of turgor pressure. Seeds normally have an upward trajectory.

Red fir dwarf mistletoe does not spread rapidly following establishment. Vertical spread in a tree averages less than 3 inches per year. Horizontal spread in a stand without overstory infection is also quite limited. The dense foliage of red fir limits spread because of the high probability of interception of the seed. Spread from infected overstory to understory may be up to about 100 feet, but it is usually less; the actual distance is dependent on slope, wind, and other factors. Trees less than 3 feet tall have a very limited chance of infection because of their small target size.

MANAGEMENT ALTERNATIVES

1. NO ACTION. The stand will be managed under present conditions. The larger trees will continue to grow, although many at rates less than optimum because of competition. In the dense aggregations of seedlings, very little growth is expected. There will be some natural thinning as severely suppressed trees die. Dwarf mistletoe will slowly spread and intensify in the stand. The rate will be greater in the immediate vicinity of larger infected trees that were left and remain as an overstory. Also, infected red fir in adjacent stands around the edge of the harvested stand will continue to disseminate seed and infect the regeneration. These two sources of overstory infection will increase the severity of dwarf mistletoe in the regeneration. The result will be a stagnated stand that will become increasingly infected and impacted by dwarf mistletoe and will not produce an acceptable commercial stand in the projected rotation period.

The slow growth rate of the trees will cause a slow healing of logging wounds, thereby keeping the wood exposed longer and increasing the amount of decay. This will increase the amount of cull in the future stand. The herbaceous vegetation and grass in understocked areas will continue to invade and will preclude rapid revegetation by red fir. This will result in less volume produced from the site than is projected.

2. SITE PREPARE AND REGENERATE. The stand will be site prepared and then planted with red fir and other appropriate species. Vegetation management treatments will be performed, when appropriate, to maintain proper growth of the stand. Dwarf mistletoe from the previous stand will not be present in the new stand with the removal of all of the residual red firs. A non-host species will be regenerated as a buffer on the edge of the stand to prevent reinfection. This buffer, in general, only needs to extend 100 feet from the adjacent overstory, although variations in distance may be appropriate, depending on the specific situation. Decay from logging wounds will not be present in the future stand, unless wounding occurs during any future entries. Proper vegetation management will reduce competition, and proper spacing throughout the area will result in crown closure that will reduce future brush competition. Inadequate treatment of the lupine and grasses prior to regeneration may result in a buildup of a pocket gopher population and subsequent loss of seedlings.

With proper timing and application of treatments, this stand will attain projected volume yields over its rotation. Pest losses will be minimal if the stand is maintained in a healthy, vigorous state.

3. PRECOMMERCIALLY THIN AND REGENERATE. The existing regeneration will be retained. Two treatments will be necessary. In the dense aggregates of red fir, a precommercial thinning will be performed to reduce stocking to levels that will maintain adequate growth and occupy the site until the first commercial thinning. Selection criteria should include previous height growth, percent live crown, the amount of logging damage, spacing, and dwarf mistletoe infection. In understocked areas, vegetation management treatments aimed at reducing grass and herbaceous competition will be necessary to provide for

successful regeneration. These areas will then be planted with species appropriate to the site. Non-host species will be planted in understocked areas around the edge of the stand if dwarf mistletoe reinfection is a concern.

Leave trees, if properly selected, will respond in height and diameter growth within several years of release. The rapid height growth will outpace the vertical spread of dwarf mistletoe. With time, the amount of uninfected crown will proportionately increase and reduce the impact of dwarf mistletoe. Trees immediately surrounding larger infected trees may be infected in their upper crown. However, the effects of reduced competition and increased height growth will limit the impacts of infection. Horizontal spread in the stand from these infected "overstory" trees will be relatively slow and will have little effect during the remainder of the rotation.

Proper selection of leave trees should result in few trees with logging wounds left in the stand. Those that are left should be the trees with no or small wounds. Because of small wound size and increased tree vigor, wound closure should occur rapidly and limit the amount of decay. Also, decay columns will not exceed the tree's diameter that exists at the time of wounding, unless additional wounding occurs.

With proper timing and application of treatments, this stand will attain projected volume yields over its rotation. The length of time remaining until the next regeneration cut will be reduced by saving the advanced regeneration. Pest losses will be minimal if the stand is maintained in a healthy, vigorous state.